

Automated tool support system of a large machine-building enterprise

A Bogoyavlensky^{1,2} and A Sirotiyuk¹

¹ Department of metal-cutting machines and tools, Ural Federal University named after the First President of Russia B N Yeltsin, 19, Mira str., Yekaterinburg, 620000, Russia

E-mail: ²a.v.bogoiavlensky@urfu.ru

Abstract. The importance of proper organization of the enterprise's tool supply increases with the increase in its size and significantly affects the efficiency of the main production. The success of the entire enterprise, the quality of products, the rhythm of work and profitability largely depend on the correct organization of the tool supply. The main tasks of the tool supply: timely and uninterrupted provision of workshops and workplaces of the main production with high-quality technological equipment and tools (cutting, measuring, auxiliary tools); improving the quality of equipment and organizing its rational operation; reducing the cost of manufacturing, purchasing, storing and operating equipment; organization of sharpening and restoration of the tool. An automated system is required to solve all tasks related to control and management of the company's tool supply. This article discusses the construction of a unified tool support system for a large enterprise and the results achieved by the authors on its development.

1. Introduction

Existing tool accounting systems do not track the tool at all stages of its life cycle, only from receipt at the factory to storage in the shop. The standard scheme for moving tools to the shop is as follows: purchase > acceptance on the company's balance sheet > sending to tool-distribution storerooms > issuing tools at the request of workers. The tool is immediately issued to the workers just by writing in the log book. The following questions arise in the process of such accounting:

- whether the tool is used on the machine or is in the worker's locker;
- was it used directly for the parts it was intended for;
- whether the optimal cutting conditions were applied, whether the processing technology was observed;
- how many parts were processed and whether the tool life is consistent with the standard data;
- analysis of the causes of frequent tool breakdowns;
- theft of tools.

The lack of such information leads to inefficient use of the tool.

At large enterprises, the technological processes development is carried out simultaneously in several technology departments that are not connected with each other, and do not have information about the availability of tools in warehouses. Technologists can use the same type of tool from different manufacturers in the technical process, which will complicate the process of purchasing tools and increase the inventory of tools in warehouses. In the existing conditions, the tool request is submitted by the tool shop services. However, the list is not checked against the production plan,



equipment connection, and list of approved tool manufacturers, is not fully checked. The supply department orders the tool from suppliers or conducts a tender procedure while a comparative analysis of the cost and functional characteristics of the tool from different manufacturers is not carried out due to the large list of purchased tools.

Tools and equipment of own production are designed by special design bureaus and manufactured in accordance with the tasks of the technological bureaus of the workshops. The process from the design of a special tool to its use in the shop is long and must be monitored to ensure the release of new products in the specified time frame. The process of manufacturing a special tool is usually monitored using paper document flow. After manufacturing, the special tool and accessories are included in the general database for the tool, where it is aligned with other tools and when ordering a new special tool, it is impossible to find the analog.

To solve or at least minimize the problems mentioned above, an automated tool support system (ATSS) is needed that will store all the data about the tool in a unified database. We can obtain an all aspects control of the tool's lifecycle in this case.

2. Methodology

Tool support issues are widely discussed in existing publications. It is indicated that the tool provision is not given due attention, considering it as a second-rate process [1]. A number of authors consider the issues of economic efficiency and optimization of the purchasing and accounting processes of tool [2, 3]. Much attention is also paid to the development and analysis of tool usage [4–8], the analysis and search of unused tools, the formation of a knowledge base structure of the tools, the need to integrate tool support and existing product lifecycle management (PLM) and enterprise resource-planning (ERP) systems [8–14]. Publications on tool support issues have started to appear intensively in recent years. This allows us to conclude that the relevance of this topic has increased.

The authors believe that all issues of tool support should be considered in a complex, starting from the departments that need information about the tool. ATSS should cover all divisions of the enterprise that are somehow related to the tool, without exception. First of all, the main production workshops, where, due to the tasks set, the maximum tool turnover occurs. Auxiliary shops should also be included in the system field. The main enterprise divisions working with information about the tools is shown in Figure 1. Each division needs only a part of the general information about the tool. For example, financial services are more interested in information about the cost of the tool and its suppliers, and technology services are more interested in information about the geometry of the tool and its technological capabilities. Shops in the system can see the list of tools and the quantity in the enterprise warehouses. The tool Department, purchasing or ordering a tool for manufacturing, keeping records of the entire tool, has access to all types of information displayed in the system. Employees of the Bureau of tool management in the shops will be more interested in the availability and maintenance of tools in working condition directly in the shop. Most enterprises currently have ERP systems that perform tool accounting, but they do not provide for storing data about the geometry and technological capabilities of the tool. Enterprises also have pre-production systems that have tool geometry data and a search system, but these systems are not linked. The automated tool support system should combine unrelated systems and add missing functions. Each division must have its own access to information in the ATSS with restricted rights. The general structure of ATSS in the form of enlarged blocks is shown in Figure 2. Let's look at the main blocks of ATSS in more detail.

The System for recording the arrival, usage, availability and movement of the instrument by business units is a Central system that provides accounting and financial accounting functions for the instrument. Existing ERP systems, as a rule, perform these functions, and directly at the level of production units, accounting is transferred to paper, which limits the ability to analyze the tool information.

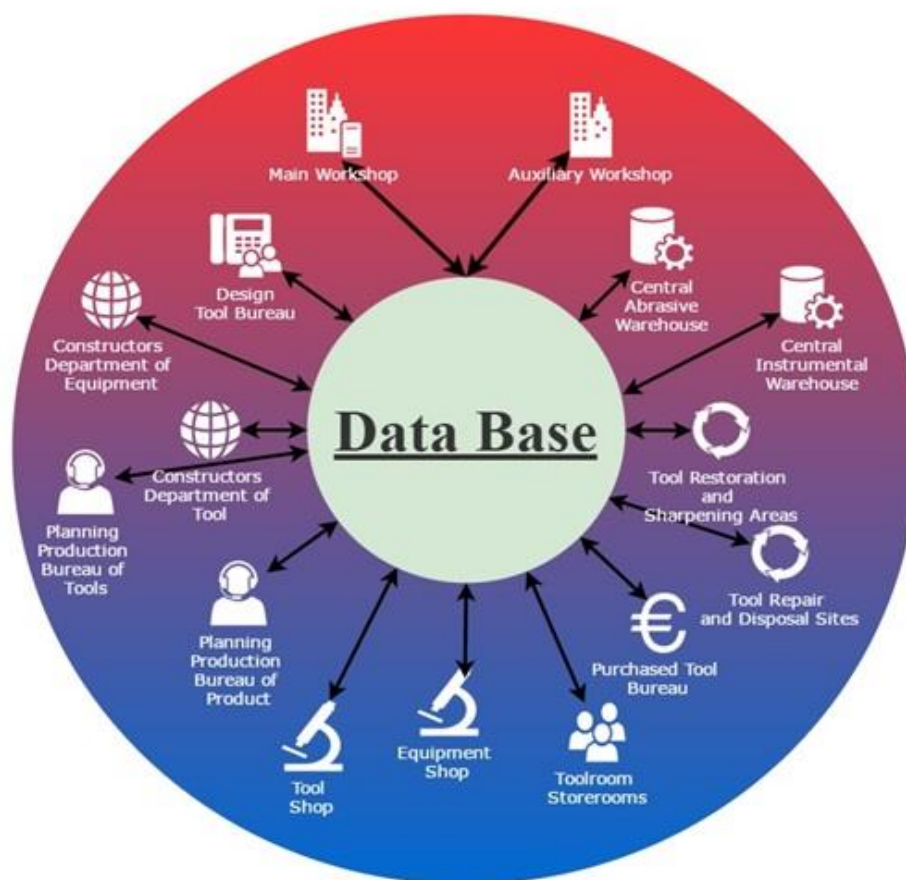


Figure 1. Users of tool support information.

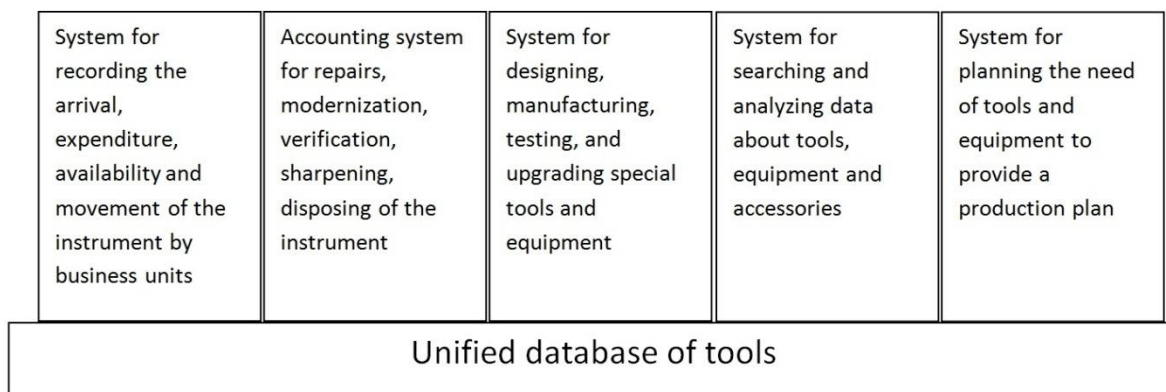


Figure 2. ATSS function blocks.

Accounting system for repairs, modernization, verification, sharpening, disposing of the instrument – currently in production, this system functions as a paper document flow, sometimes associated with an automated accounting system at the stage of tool write-off. The lack of automation of these aspects of tool support significantly limits the ability to analyze the conditions of use of the tool, identify the tool used in violation of regulations, unused tool.

System for searching and analyzing data about tools, equipment and accessories is an auxiliary system that provides the ability to find tool data, analyze its parameters, terms of use, estimate inventory, find unused tools, and perform many other tasks.

System for planning the need of tools and equipment to provide a production plan – this system allows you to plan in advance the purchase of tools and optimize the financial costs of providing tools. Currently, most enterprises make a tool purchase plan that is formed manually or with partial use of computer technology. The reason of this is a lot of parameters for correct purchase plan calculation. The tool need must be linked with the product release plan and with composition of manufactured products. The need for each type of tool for manufacturing parts, must be corresponded the current availability of tools in warehouses and in production.

System for designing, manufacturing, testing, and upgrading special tools and equipment is typical for large machine – building enterprises that have divisions for the design and production of special tools and equipment. The peculiarity of this system is the need to link in a single information flow all the work on the design of tool or equipment, the development of its manufacturing technology, manufacturing, testing and transfer to production. The process of interaction between various divisions of the enterprise in the process of providing with special tools and equipment is shown in Figure 3.

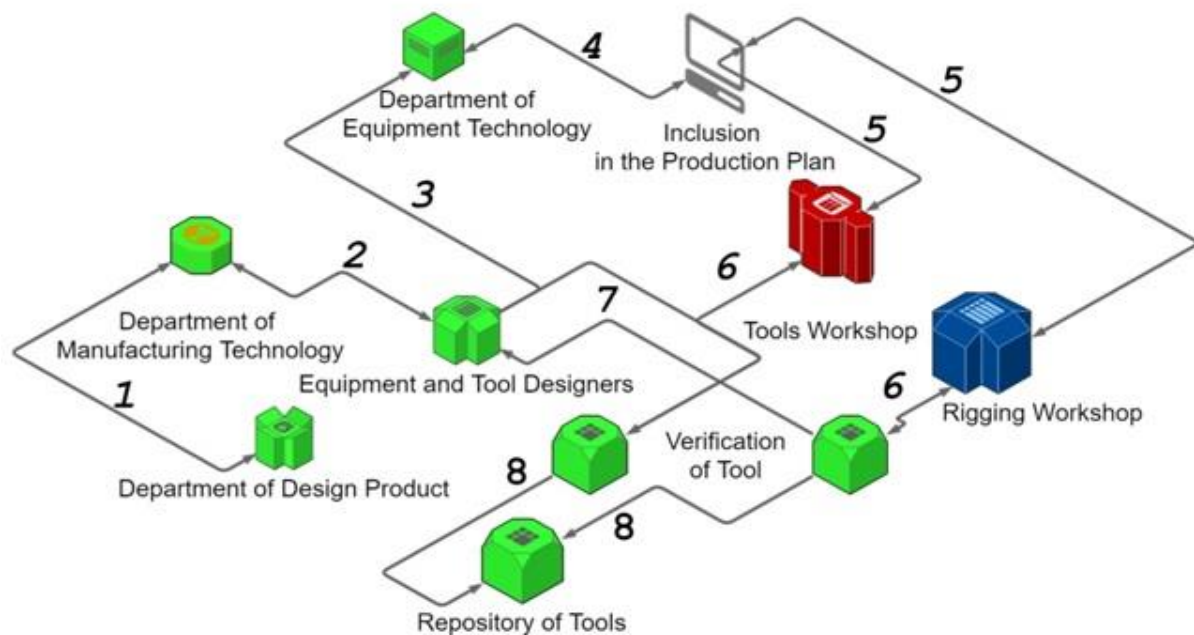


Figure 3. Scheme of providing special tools and equipment.

Numbers in the diagram Figure 3 show the sequence of design operations and the appearance of information in the database of tools. This ATSS function block is actually a workflow from ordering a special tool to commissioning it. By this way the tool or tooling is designed, planned, manufactured, tested, and transferred to the warehouse. The production process of special tools and especially equipment does not always go smoothly. Sometimes during the testing stage, some problems are detected, and the process is repeated from previous stages. The process is complex and must be constantly monitored.

3. Result

As a result of the research, a database for ATSS was developed. The distribution of information across the database tables is shown in Figure 4. Currently, we are developing and programming computer forms for viewing information about the tool for various departments of the enterprise.

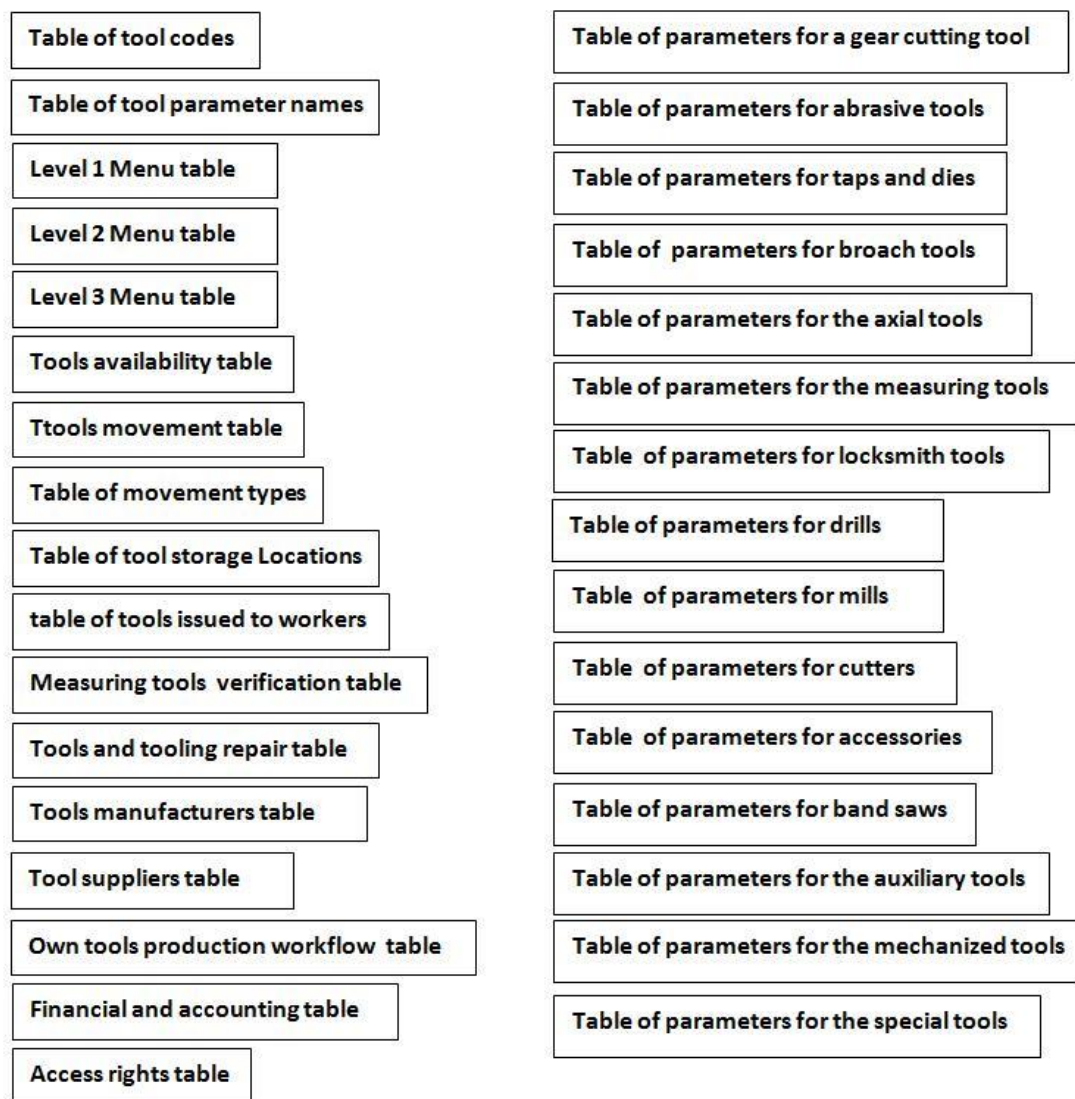


Figure 4. Data storage structure of an automated tool support system.

4. Conclusion

Tool support issues are not fully automated at the moment. It is necessary to develop an automated tool support system that should resolve all outstanding issues. The ATSS should be linked to existing systems of technological preparation of production and ERP systems and work as a single complex to improve enterprise production efficiency.

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